

WHAT IS CLAIMED IS:

1. A system for use with a plating cell configured to plate objects in a plating process wherein at least one byproduct is created in a plating substance used in the plating cell, the system comprising:

42
a purification system configured to remove at least a portion of the at least one byproduct from the plating substance, wherein the purification system comprises at least

a first processing vessel,

a second processing vessel, and

a flow path providing flow from the first processing vessel to the second processing vessel, wherein the flow path is configured such that the flow from the first vessel to the second vessel is caused by gravity.

2. The system according to claim 1, wherein the first processing vessel comprises a reacting vessel configured to remove said at least a portion of the at least one byproduct.

3. The system according to claim 2, wherein the reacting vessel is configured to supply at least one gas in the reacting vessel to react with the at least one byproduct.

4. The system according to claim 3, wherein the gas comprises ozone.

5. The system according to claim 3, wherein the reacting vessel is configured to supply ultraviolet light in the reacting vessel.

6. The system according to claim 3, wherein the second processing vessel is a degassing vessel configured to remove gas in the plating substance.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

14. The system according to claim 13, wherein the gas comprises ozone.

15. The system according to claim 13, wherein at least one of the reacting vessels is configured to supply ultraviolet light to increase the reaction between the at least one byproduct and the gas.

16. The system according to claim 13, wherein the second processing vessel is a degassing vessel configured to remove gas in the plating substance.

17. The system according to claim 16, wherein the degassing vessel is configured to supply at least one second gas to facilitate degassing of the plating substance.

18. The system according to claim 17, wherein the second gas comprises nitrogen.

19. The system according to claim 11, wherein each of the first and third processing vessels includes an inlet near its top and an outlet near its bottom, wherein the second processing vessel includes an inlet near its top, and wherein the inlet of the second processing vessel is lower than the inlets of the first and third processing vessels.

20. The system according to claim 19, wherein the inlets of the first and third processing vessels are at substantially the same height.

21. The system according to claim 20, wherein the inlet of the second processing vessel ranges from about .5 inches to about 10 inches lower than the inlets of the first and third processing vessels.

22. The system according to claim 1, wherein the first and second processing vessels are operated at atmospheric pressure.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

23. A system for use with a plating cell configured to plate objects in a plating process wherein at least one byproduct is created in a plating substance used in the plating cell, the system being configured to withdraw at least a portion of the plating substance used in the plating cell, to remove at least a portion of the at least one byproduct, and to return at least a portion of the plating substance to the plating cell, the system comprising:

a tank for containing the plating substance used in the plating cell; and
a purification system according to claim 1.

24. The system according to claim 23, further comprising a pump for withdrawing at least a portion of the plating substance from the tank.

25. The system according to claim 23, further comprising a return pump for returning at least a portion of the plating substance to the tank.

26. The system according to claim 25, wherein the purification system includes a level detector associated with the second processing vessel and wherein the return pump is controlled based on a level detected by the level detector.

27. The system according to claim 23, wherein the purification system includes a third processing vessel interposed between the first and second processing vessels.

28. The system according to claim 27, wherein each of the first and third processing vessels comprises a reacting vessel configured to remove said at least a portion of the at least one byproduct from the plating substance.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

29. The system according to claim 28, wherein the reacting vessel of at least one of the first and third processing vessels is configured to supply at least one gas to react with the at least one byproduct.

30. The system according to claim 29, wherein the gas comprises ozone.

31. The system according to claim 29, wherein at least one of the reacting vessels is configured to supply ultraviolet light to react with the at least one byproduct and the gas.

32. The system according to claim 29, wherein the second processing vessel is a degassing vessel configured to remove gas in the plating substance.

33. The system according to claim 32, wherein the degassing vessel is configured to supply at least one second gas to facilitate degassing of the plating substance.

34. The system according to claim 33, wherein the second gas comprises nitrogen.

35. The system according to claim 28, wherein each of the first and third processing vessels includes an inlet near its top and an outlet near its bottom, wherein the second processing vessel includes an inlet near its top, and wherein the inlet of the second processing vessel is lower than the inlets of the first and third processing vessels.

36. The system according to claim 35, wherein the inlets of the first and third processing vessels are at substantially the same height.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

37. The system according to claim 36, wherein the inlet of the second processing vessel ranges from about .5 inches to about 10 inches lower than the inlets of the first and third processing vessels.

38. A system for use with a plating cell configured to plate objects in a plating process wherein at least one byproduct is created in a plating substance used in the plating cell, the system comprising:

a purification system configured to remove at least a portion of the at least one byproduct from the plating substance, wherein the purification system comprises at least

a first processing vessel, wherein the first processing vessel includes an inlet near its top and an outlet near its bottom,

a second processing vessel, wherein the second processing vessel includes an inlet near its top, and wherein the second processing vessel is arranged such that the inlet of the second processing vessel is lower than the inlet of the first processing vessel, and

a flow path providing flow from the outlet of the first processing vessel to the inlet of the second processing vessel.

39. The system according to claim 38, wherein the first processing vessel comprises a reacting vessel configured to remove said at least a portion of the at least one byproduct, wherein the reacting vessel is configured to supply at least one gas in the reacting vessel to react with the at least one byproduct.

40. The system according to claim 39, wherein the reacting vessel is configured to supply ultraviolet light in the reacting vessel.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

41. The system according to claim 39, wherein the second processing vessel comprises a degassing vessel configured to remove gas in the plating substance.

42. The system according to claim 38, wherein the inlet of the second processing vessel ranges from about .5 inches to about 10 inches lower than the inlet of the first processing vessel.

43. The system according to claim 38, wherein the purification system includes a third processing vessel interposed between the first processing vessel and the second processing vessel, wherein the third processing vessel includes an inlet near its top and an outlet near its bottom, wherein the outlet of the first processing vessel is flow connected to the inlet of the third processing vessel, and the outlet of the third processing vessel is flow connected to the inlet of the second processing vessel.

44. The system according to claim 43, wherein at least one of the first and third processing vessels comprises a reacting vessel configured to supply at least one gas to react with the at least one byproduct.

45. The system according to claim 44, wherein the reacting vessel is configured to supply ultraviolet light.

46. The system according to claim 45, wherein the second processing vessel comprises a degassing vessel configured to remove gas in the plating substance.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

47. The system according to claim 46, wherein the inlet of the second processing vessel ranges from about .5 inches to about 10 inches lower than the inlets of the first and third processing vessels.

48. A system for use with a plating cell configured to plate objects in a plating process wherein at least one byproduct is created in a plating substance used in the plating cell, the system being configured to withdraw at least a portion of the plating substance used in the plating cell, to remove at least a portion of the at least one byproduct, and to return at least a portion of the plating substance to the plating cell, the system comprising:

a tank for containing the plating substance used in the plating cell; and
a purification system according to claim 38.

49. The system according to claim 48, further comprising a pump for withdrawing at least a portion of the plating substance from the tank.

50. The system according to claim 48, further comprising a return pump for returning at least a portion of the plating substance to the tank.

51. The system according to claim 50, wherein the purification system includes a level detector associated with the second processing vessel and wherein the return pump is controlled based on a level detected by the level detector.

52. The system according to claim 48, wherein the purification system includes a third processing vessel interposed between the first and second processing vessels, wherein the third processing vessel includes an inlet near its top and an outlet near its bottom, wherein the outlet of the first processing vessel is flow

connected to the inlet of the third processing vessel and the outlet of the third processing vessel is flow connected to the inlet of the second processing vessel.

53. A method for removing at least a portion of at least one byproduct from a plating substance used in a plating cell, the method comprising:

flowing a used plating substance from the plating cell to a purification system configured to remove at least a portion of at least one byproduct from the used plating substance, wherein the purification system comprises at least

a first processing vessel,

a second processing vessel, and

a flow path providing flow from the first processing vessel to the second processing vessel, wherein the flow path is configured such that the flow from the first processing vessel to the second processing vessel is caused by gravity;

passing the used plating substance from the first processing vessel to the second processing vessel by gravity; and

removing at least a portion of the at least one byproduct from the used plating substance in at least one of the first and second processing vessels.

54. The method according to claim 53, wherein the first processing vessel comprises a reacting vessel configured to remove said at least a portion of the at least one byproduct, and wherein the method further comprises supplying at least one gas within the reacting vessel such that said at least a portion of the at least one byproduct reacts with the gas.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

55. The method according to claim 54, further comprises applying ultraviolet light to the used plating substance within the reacting vessel to increase the amount of reaction between the gas and said at least a portion of the at least one byproduct.

56. The method according to claim 54, wherein the second processing vessel comprises a degassing vessel configured to remove gas in the used plating substance, and the method further comprises supplying at least one second gas to the used plating substance within the degassing vessel such that the second gas facilitates degassing of the used plating substance.

57. The method according to claim 53, wherein the first processing vessel includes an inlet near its top and an outlet near its bottom, wherein the second processing vessel includes an inlet near its top, wherein the inlet of the second processing vessel is lower than the inlet of the first processing vessel, and wherein the passing comprises passing the used plating substance from the outlet of the first processing vessel to the inlet of the second processing vessel by gravity.

58. The method according to claim 53, wherein the flowing comprises conveying the used plating substance from a storage tank to the purification system.

59. The method according to claim 58, wherein the conveying comprises pumping the used plating substance from the storage tank to the purification system.

60. The method according to claim 58, further comprising pumping the used plating substance from the purification system to the tank with a return pump.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

61. The method according to claim 60, further comprising detecting the level of the used plating substance in the second processing vessel and adjusting the return pump based on the detected level.

62. The method according to claim 61, wherein the adjusting maintains the used plating substance at a predetermined level in the second processing vessel.

63. The method according to claim 53, wherein the purification system includes a third processing vessel interposed between the first and second processing vessels, and wherein the passing includes passing the used plating substance through the third processing vessel.

64. The system according to claim 24, wherein the purification system includes a level detector associated with the second processing vessel and wherein the pump for withdrawing at least a portion of the plating substance is controlled based on a level detected by the level detector.

65. The system according to claim 49, wherein the purification system includes a level detector associated with the second processing vessel and wherein the pump for withdrawing at least a portion of the plating substance is controlled based on a level detected by the level detector.

66. The method according to claim 60, further comprising detecting the level of the used plating substance in the second processing vessel and adjusting the pumping based on the detected level.

LAW OFFICES

FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000